REMARKS

Applicants acknowledge the 2nd Action of 18 DEC. 2003 and request reconsideration of the claims, as amended. Main method claim 14 and main apparatus claim 25 have been amended for greater clarity and to highlight the inventive concept. In particular, references which suggest updating a memory <u>after</u> a motor or engine is powered OFF are clearly **no longer relevant.** In order to avoid possible controversy as to whether amendment "raises a new issue," the RCE is being filed simultaneously. Claim 29, as amended, is supported at page 1, line 14, and in the passage from page 18, par. 5, though the middle of page 19. Specification page 1 states that the transfer of data from the volatile memory to the nonvolatile memory is preferably performed "when the microprocessor has spare time, for example between commutation operations" so it is clear that, while this is done at substantially regular intervals, the intervals need not be precisely "predetermined" as originally implied by claim 14.

Before discussing the prior art, a brief review of how the present invention works may facilitate understanding.

According to the invention, as shown in FIG. 2, an electronically commutated motor (ECM) 32 is used, whose commutation (switching of currents passing through the windings) is controlled by a computer 23 which outputs signals OUT1 and OUT2, which control the motor. In the electric motor arts, one calls this process "electronic commutation." Previously,

commutation was performed *mechanically* using a commutator, which had many lamellae, across which carbon brushes slid, to make and break the electrical contacts which completed a circuit through the winding(s). Now that this function is done electronically, the carbon brushes (which tended to wear out) are not needed. Therefore, electronically commutated motors (ECM) are also called "brushless" motors.

Electronic commutation by means of a computer is a specialty of the PAPST company, the assignee of the present application, where this kind of electronic commutation was invented. The company is internationally known for building motors and fans of this type.

Computer 23 is typically an inexpensive microcontroller, into whose ROM has been burned a program by the manufacturer. A frequent application of such motors with computer-control is for fans, as shown in FIG. 1 at 32, and such fans cost only a few dollars, so the computer 32 normally costs **less than a dollar**; otherwise, there would be no "budget" left for the other motor components.

Assuming that the electric motor runs at 6 000 RPM (revolutions per minute), that means 100 RPS (revolutions per second) and, assuming that its rotor 130 has four poles, as shown in FIG. 2, the computer 23 must alter the current direction in the winding **400 times per second**, and at precisely specified instants in time. This is controlled by a Hall generator 132, whose output signal HALL, as shown in FIG. 4, is fed to computer

23 and actuates Interrupt-Routine 147 400 times per second, as shown in FIG. 13. At step S153, there is a test as to what value the signal HALL has. When the signal HALL changes, at an edge of this signal, step S159 resets both signals OUT1 and OUT2 to 0, so that, in this example, for a brief time no current flows in full bridge circuit 112 and consequently no short-circuit can happen.

Subsequently, in step S161, there is a test as to which value the signal HALL has, and correspondingly either signal OUT1 is set to 1, meaning that OUT2 retains the value 0 from step S159, or conversely signal OUT2 is set to 1, meaning that OUT1 retains the value 0 from step S159. OUT1 = 1 can mean that, in FIG. 2, both transistors 144 & 118 become conductive, and a current flows in winding 128 from top to bottom. Conversely, when OUT2 = 1, transistors 116 & 120 of FIG. 2 are conductive, and the current in winding 128 flows from bottom to top.

The foregoing is a primitive example of electronic commutation of such a motor, and this **must always happen at the correct instant**; otherwise, if the commutation happens sometimes too early and sometimes too late, motor 32 runs very irregularly and generates loud noises, which makes it practically unsaleable.

FIG. 13 illustrates the fact that, in step S167, at every commutation, a commutation counter is incremented by 1, and that, in steps S169, S171, when the commutation counter goes over 9999, it is set back to 1, and the value OD_COM is incremented by 1. Thus, counter OD_COM counts up by 1 for each 10,000 commutations.

In this example, the current value of OD_COM is stored about every 10 minutes in a non-volatile memory, and thus provides a metric for the usage of the motor, i.e. for the number of its rotations. This storage step happens in step S200 of FIG. 15. All of this is thoroughly discussed in the description accompanying FIG. 13.

Assuming that motor 32 runs at 100 RPS and that therefore the direction of current flowing in winding 128 must change 400 times per second, one thus has 400 switching events, i.e. the time between two switching events is approximately 1 000 000/400 = 2500 microseconds. However, computer 23 must also perform all its other tasks, e.g. regulate the rotation speed as a function of temperature at a resistor 62 (FIG. 2), monitor against errors, generate a signal ALARM_OUT (FIG. 2) in case an error is detected, communicate over an external bus 82 (FIG. 2) and perform regular storage of data into the non-volatile memory 74, namely the EEPROM 72 shown in FIG. 2.

According to the example disclosed, certain data are stored about every 10 minutes, while the time interval between storing steps can vary due to computing processes, e.g. by +/- 100 microseconds.

The reason for performing the storing steps *during motor rotation* is the following: when a fan or similar motor is shut off, it becomes immediately current-less and can therefore

no longer store anything. The storing therefore happens, according to the invention, **during operation** and at regular intervals, which naturally cannot be too widely spaced in time.

The motor has a RAM 97 (FIG. 2) and various data in it are continuously updated, as routine S638 of FIG. 15 illustrates. For example, steps S190, S192 monitor whether the operating voltage U_B has exceeded a previously-stored "older" value OD_UBM. If Yes, the stored value OD_UBM is overwritten by the new, higher value U_B.

If the motor is dimensioned for 12 V, and a voltage of 28.5 V is applied to it, the value 28.5 V is stored and remains stored until a higher value, e.g. 28.7 V, occurs.

The same applies to steps S194, S196, with the temperature T, which in FIG. 1 is measured at 152. If the motor has once reached 130° C, the value 130° remains stored until the motor on a hot day reaches 135° C, and the value 135° C is then stored, overwriting the old value of 130° C.

The routine shown in FIG. 15 is called every ten minutes by the routine shown in FIG. 14. The routine of FIG. 14 sets the flag FCT_BDF = 1. This has the effect, in step S636 of FIG. 6, that routine S638 (FIG. 15) is called up, whenever computer 23 momentarily has nothing more important to do, and then routine S638 stores, in EEPROM 74, the values for operating voltage (if it has gone higher), for the temperature (if it has gone higher), for the operating hours OHO (in S198) and for the count of commutations divided by 10,000 (in S200).

In this manner, the motor receives, in its EEPROM, non-volatile data about the operating hours (albeit somewhat lower than the actual operating hours), very precise data about the highest operating voltage reached, very precise data about the highest temperature reached, and slightly low data about the count of commutations divided by 10,000, i.e. about the count of prior rotations. Since many such fans run constantly, and are seldom turned off, in practice the stored values represent an accurate picture of reality.

PRIOR ART REJECTIONS

Claims 14-25 & 29-30 have been rejected as anticipated by DeWILLE, and claims 26-28 have been rejected as obvious over a combination of DeWILLE with the Philips I^2C bus article.

DeWILLE/SIEMENS (USP 6,167,338) <u>issued</u> 7 months <u>after</u> the May 2000 PCT filing date of the present application, but nevertheless has an early effective date because of its U.S. filing on 15 SEP. 1998. DeWILLE is directed to the control of a motor vehicle automatic transmission (see col. 6, lines 21-27) and the storage of values of this transmission in a flash memory (FIG. 1).

Since a flash memory can only be rewritten about 10 000 times, one manufactures it larger than necessary, e.g. in two segments as shown in FIGS. 6 & 7, with each segment over-dimensioned. One stores alternately in segment 1 or segment 2, the currently unused segment being erased, so that it can be subsequently rewritten. One calls this a "circular buffer

method" (see col. 3, lines 58-59). The advantage is that one can use an inexpensive flash memory, which will hold out for the expected service lifetime of the auto.

Prior to a storing step, one does not know <u>where</u> one may currently store (see col. 3, line 61: no longer located at fixed addresses). Therefore, one must, <u>prior</u> to storing, <u>search</u> for a free location in memory. This happens according to the routine of FIG. 8 (see col. 9, line 66, to col. 10, line 33). According to FIG. 9, a pointer table is created.

If it becomes necessary to fall back upon a previously written segment of the flash memory, one must first transfer important data from this segment into the RAM (Random Access Memory). One then clears or erases the segment, transfers the data from the RAM back into the segment, and additionally transfers new data blocks, as shown in FIG. 15 and described at col. 13, lines 58 through 65.

Since one does not know, <u>where</u> in the flash memory the data are located, in order to find the data at all, one must provide a header and a tail, as shown in FIG. 2. As described at col. 7, lines 25-38, the data block contains a header (HDR), a TYP code designating a corresponding buffer in RAM, an ID code which designates the type of data, a UMF section which signals the number of data bytes, a checksum CS, an END, and a block checksum BCS.

Such data blocks are created in RAM, according to FIG. 13, <u>after</u> the vehicle ignition has already been shut off, i.e. when the OFF command is applied to the control module, a storing step occurs at 12 and voltage switchoff follows at 13.

The reason for this is that this part of the RAM, <u>during operation</u> of the auto, serves **other purposes** than it serves <u>after</u> switchoff of the ignition; see col. 12, lines 29ff: "The RAM position is normally used by other program parts. However, **since these no longer run** (next action after the flash memory programming is to reset the system or switch off the voltage), this area can be used without disrupting the other programs."

According to FIG. 13, the data blocks 2 generated in RAM are, after their creation, transferred into the adaptive region of the flash memory 1.

These are <u>complex and slow</u> operations, which can last up to a full minute after the shutdown of an internal combustion engine and such operations could never be carried out <u>during</u> auto operation, since <u>while driving</u> the RAM 16 is needed for other purposes (for the other program parts, see col. 12, line 30). These procedures are much too complicated and slow; in a traveling vehicle, attempting to perform these operations would so monopolize the computing resources that the transmission would be blocked or frozen for multiple seconds, with unacceptable safety consequences.

According to FIG. 14A (top right corner) of DeWILLE, prior to every storing operation, a test is made, whether the checksum

of the relevant value has changed. The value is stored only if it has gotten smaller or bigger, not if it has remained the same. This conserves time in the storing process, but teaches away from the present invention's method of storing a value only when it has changed in one direction, e.g. when the operating temperature has increased. DeWILLE would also store, whenever the temperature decreased.

DeWILLE clearly recognizes the desirability of storing data about overtemperature or other warranty-voiding conditions (col. 4, lines 5-14) but teaches storing values for only a limited number of past trips of the vehicle, and regularly erases older data, even when these older data contain higher temperature values, i.e. DeWILLE would indeed store data that a temperature went too high, but would do so for only a limited period of time, and would then erase these data to make room for new storing operations.

Contrary to the suggestion of the Office, the procedures taught by DeWILLE could not be used during the operation of an electronically controlled motor. DeWILLE states quite explicitly that, due to the complexity of the procedures, the RAM must be used for dual purposes (see FIG. 13, double-used RAM area), so that storing is possible only after the ignition has been shut off, and never while the vehicle is running. The RAM updates data continuously, but these data are stored only temporarily, while the vehicle is running.

DeWILLE thus teaches directly away from the concept of performing storing at regular intervals, into non-volatile memory, during operation so that, upon shutoff of an electric motor, one has available operating data which are not completely up-to-date but are *sufficiently current* to facilitate a re-start. In an inexpensive device such as a cooling fan or similar electric motor, recently updated non-volatile data suffice for operating purposes.

The DeWILLE teaching is a Siemens luxury solution for the Cadillac driver. The solution provided by the present PAPST invention is a simple solution for an inexpensive device which typically costs only a few dollars. Toward this simple and inexpensive solution, DeWILLE provides not the slightest suggestion; rather, DeWILLE **teaches away** from the steps recited in claim 14 and from the structure recited in claim 25. If one were to try adapting the teaching of DeWILLE for use in an electric motor, one would need a special circuit to cover the shutoff situation, so that operating voltage would still be available after the motor ceased to run. Such an extra circuit would likely double the cost of such a device, and would be financially unacceptable to the typical customer of the Papst company's electric motors.

CONCLUSION

In view of the foregoing amendments and arguments, it is respectfully submitted that claims 14, 25 and 29, and their respective dependent claims, are clear and patentably distinguish over DeWILLE, PHILIPS, and the other art of record, taken singly or in combination. If the Patent Office notes any remaining informalities which would need to be resolved to place the application in condition for allowance, a telephone call to Applicants' counsel is requested.

Respectfully submitted,

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